SEVENTEENTH ANNUAL REPORT

OF THE

YELLOWSTONE RIVER COMPACT COMMISSION

1968

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YELLOWSTONE RIVER COMPACT COMMISSION

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MONTANA WATER RESOURCES BOARD
SAM W. MITCHELL BUILDING
HELENA, MONTANA
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Governor Forrest H. Anderson, Chairman
WILBUR WHITE, VICE CHAIRMAN AND SECRETARY, TWODOT
DONALD L. DELANEY, MISSOULA
CLYDE HAWKS, ST. XAVIER
EVERETT V. DARLINTON, DIRECTOR, HELENA
SID KURTH, BILLINGS
H. J. SAWTELL, MILES CITY

January 13, 1969

The Honorable Forrest H. Anderson
Governor of Montana
State Capitol
Helena, Montana 59601

Dear Governor Anderson:

As provided in the Yellowstone River Compact, we are forwarding to you a copy of the Seventeenth Annual (1968) Report of the Compact Commission.

Sincerely,

MONTANA WATER RESOURCES BOARD

Everett V. Darlinton
Director

EVD/km
Encl.

YELLOWSTONE RIVER COMPACT COMMISSION

421 Federal Building
Helena, Montana

December 26, 1968

Honorable Stanley K. Hathaway
Governor of the State of Wyoming
Cheyenne, Wyoming

Honorable Tim M. Babcock
Governor of the State of Montana
Helena, Montana

Honorable William L. Guy
Governor of the State of North Dakota
Bismarck, North Dakota

Sirs:

Pursuant to Article III of the Yellowstone River Compact, the Commission makes the following seventeenth annual report of activities for the period ending September 30, 1968.

The Commission met at Sheridan, Wyoming on July 16, 1968 for its eighteenth meeting. The primary purpose of this special meeting was to review the stream gaging being done in the Yellowstone River basin and consider what needs there may be for additional hydrologic data and research to properly administer the Compact in future years when the demands for water become greater and allocations necessary. Mr. Floyd A. Bishop, Wyoming State Engineer and Mr. Everett V. Darlinton, Director, Montana Water Resources Board, the designated representatives of their respective states, were present. Mr. Harlan M. Erskine, designated Federal representative, served as chairman and secretary. Others present were A. J. Mancini, Don Sullivan and George B. Maxey, Montana Water Resources Board, Helena, Montana; William Long, Wyoming Board of Control, Acme, Wyo.; Carl R. Oslund, Reynolds Mining, Sheridan, Wyo.; Charles W. Lane and George M. Pike, U. S. Geological Survey, Helena, Mont.; and Leon A. Wiard, U. S. Geological Survey, Cheyenne, Wyoming.

The seventeenth annual meeting was held at Billings, Montana on November 15, 1968 with Commissioners Bishop, Darlinton and Erskine present. Also attending were Don Sullivan and T. P. McNulty, Montana Water Resources Board, Helena; and Charles W. Lane and George M. Pike, U. S. Geological Survey, Helena, Montana.

The Compact Commission met informally in Billings with Bureau of Reclamation officials on January 23, 1968 at which time Bureau personnel described the studies they had made and options they had executed for the sale of water for industrial purposes from the Bighorn River.

During the year ending September 30, 1968, annual streamflow at the designated points of measurement in Montana ranged from 103 to 165 percent of the 1945-60 averages. Although some flows were a little lower than during the preceding year, irrigation needs were supplied satisfactorily. Storage in the major reservoirs was appreciably higher at the close of the year than it was at the beginning except for the Yellowtail Reservoir which had been drawn down moderately in connection with maintenance activities.

There were no developments during the year which required allocations of water in accordance with the provisions of the Compact. The State Commissioners are of the opinion that the present water resources development does not warrant verification or study of allocable use.

Interest in possible future large industrial water supply developments from major rivers in the Yellowstone River basin continues to grow; however, no additional options for water were executed during the year. Studies and planning relative to additional development of the Tongue River Project being done for Montana by the Bechtel Corporation are expected to be completed before the end of 1968. The Bureau of Reclamation proceeded with the investigation of several possible sites for reservoirs, particularly in the Powder River basin.

The Commission called the need for better information on consumptive use and return flows associated with irrigation as practiced in the valleys of the principal tributaries of the Yellowstone River to the attention of the Water Resources Research Institutes in Montana and Wyoming. The Directors of each expressed interest and have prepared proposals for coordinated research projects in each state which are designed to provide valuable information on the subject. If approved by the Office of Water Resources Research, the projects are planned to get started on July 1, 1969 and continue for a period of three years.

The expense of the Commission during the fiscal year ending June 30, 1968 was $9,000, and a like amount is being budgeted to cover anticipated costs during 1969 fiscal year. Budgets totaling $28,700 are being sought for the biennium July 1, 1969 to June 30, 1971 to continue the existing program, relocate the station on Clarks Fork at a site farther downstream where it will be more in keeping with the needs of the Commission, and to provide for one new gaging station. Budget estimates for each year of the biennium are as follows:

July 1, 1969 to June 30, 1970:

Continuation of existing program.....	$ 9,500
Installation of replacement recording gaging station on Clarks Fork below Edgar	3,200

July 1, 1970 to June 30, 1971:

Continuation of existing program.....	9,500
Installation of one new gaging station, location to be selected at later date.....	5,000
Operation of the new station	1,500
Total for the biennium.....	$ 28,700

Respectfully submitted,

Floyd A. Bishop
Commissioner for Wyoming

Everett V. Darlinton
Commissioner for Montana

Harlan M. Erskine
Federal Representative

Cost:

The work of the Commission, which to date has been primarily concerned with the collection of required hydrologic data, has been financed through cooperative arrangements whereby Montana and Wyoming each bear one-fourth of the cost and the remaining one-half is borne by the United States. The salaries and necessary expenses of the State representatives and hydrologic data made available by other agencies are not evaluated or considered as expense of the Commission.

The expense of the Commission during the fiscal year ending June 30, 1968 was $9,000 in accordance with the budget adopted for that year.

The budget for fiscal year ending June 30, 1969 was initially arranged by earlier negotiation between the cooperating agencies and verified at the annual meeting. It is summarized as follows:

Gaging station operation and supplementary periodic measurements of discharge at auxiliary points	$ 8,000
Data assembly, report preparation and secretarial functions	1,000
Total	$ 9,000

Gaging stations:

The collection of discharge records at sites specified in the Rules and Regulations, or at a substitute site for the Clarks Fork of the Yellowstone River, was continued. The Clarks Fork of the Yellowstone River records are being collected at a gaging station at Edgar, about four miles upstream from the Whitehorse Canal diversion and six miles upstream from the mouth of Rock Creek. During the diversion season, periodic supplementary measurements were made of the flow in Whitehorse Canal and the Clarks Fork a short distance upstream from Rock Creek to establish flow relationships. The results were inconclusive.

Plans have been made to relocate the gaging station on Clarks Fork at a site a short distance above Rock Creek. This change is now scheduled for 1970 fiscal year; a delay of one year has occurred because of insufficient funds being available in 1969 fiscal year. In the meantime, the gaging station presently in use will be continued.

Streamflow at designated points of measurement was moderately lower than during 1967 on the Clarks Fork of the Yellowstone and Bighorn Rivers. It

ranged from 103 to 170 percent of the 1945-60 averages at the four key stations.

Details of streamflow and bar-graph comparisons with average flows during selected base periods are given in Appendix B.

Diversions:

Opinions expressed by the two State representatives indicated that allocable diversions in Montana and Wyoming initiated since January 1, 1950 did not warrant detailed consideration and that use in the upstream State did not exceed Compact allowances.

Studies of the Tongue River Project being made for the Montana Water Resources Board by the Bechtel Corporation, San Francisco, continued during the year. It is expected that the report covering design and cost estimates for the proposed project will be submitted to Montana by the end of 1968. A reservoir insuring a firm annual supply of 100,000 acre feet is envisioned. Of this amount, 60,000 acre feet would be available for industrial use and the remaining 40,000 would be tentatively allocated for agricultural use. The Bechtel study on the Tongue River has not been reviewed or endorsed by the Commission. No Commission action on the report appears to be necessary and it should be considered as a Montana study primarily for the use of that state.

It was reported that the Bureau of Reclamation was making studies of a number of possible storage developments, particularly on the Powder River and off stream near the Yellowstone River. No additional options for the sale of industrial water were executed during the year.

The Commission received a report during July from the U. S. Geological Survey relative to the adequacy of the stream-flow data collection program in the basin with respect to meeting the needs when the point is reached when allocations must be made.

The Survey recommended about 14 new gaging stations to be installed over a period of several years. The stations would generally be associated with areas where there was extensive irrigation development and they would aid in determining the consumptive use of water in these areas. Budgeting problems prevent any early installations; however, the Commission tentatively planned to provide for one of the proposed new stations in its 1971 fiscal year budget.

The Commission recognizes a serious deficiency in factual information relative to consumptive use and return flows as related to irrigation as practiced in the basins of the major Yellowstone River tributaries. Reliable information on this subject will become extremely important as the demand for water increases and allocations are required. The Commission called this situation to the attention of the Water Resources Research Institutes in Montana and

Wyoming with a recommendation that research projects in this subject area be undertaken. As a result, proposals have been submitted to the Office of Water Resources Research for coordinated research projects in each state. If approved, work on the projects could begin July 1, 1969.

Storage:

In reservoirs completed after January 1, 1950

Yellowtail Reservoir, a Bureau of Reclamation project on Bighorn River, filled to a maximum content for the year of 1,068,000 acre feet on November 2, 1967. At the close of the water year, the content was 829,400 acre feet as compared to 1,052,000 acre feet at the beginning of the year. Maintenance activities on the outlet works have been a factor which influenced the operation and lower level at the end of the year. Details regarding this reservoir are given in Appendix C.

Boysen Reservoir on the Wind River, operated by the Bureau of Reclamation, filled to a maximum content of 740,000 acre feet on August 26, 1968. As of September 30, 1968, its content was 704,600 acre feet as compared to 682,700 acre feet one year earlier. Details regarding this reservoir are given in Appendix C.

The Commission is cognizant of other reservoirs in this general group and considers their aggregate effect to be insufficient to warrant the collection of storage data at this time.

In reservoirs existing on January 1, 1950

Storage pertinent to Compact allocation in these reservoirs is confined to usage for new developments completed after January 1, 1950. This is currently considered very minor. Month-end storage data for these reservoirs is given in Appendix D as a matter of record and general information on water supply.

RULES AND REGULATIONS FOR ADMINISTRATION OF THE YELLOWSTONE RIVER COMPACT

A compact, known as the Yellowstone River Compact between the States of Wyoming, Montana and North Dakota, having become effective on October 30, 1951 upon approval of the Congress of the United States, which apportions the waters of certain interstate tributaries of the Yellowstone River which are available after the appropriative rights existing in the States of Wyoming and Montana on January 1, 1950 are supplied, and after appropriative rights to the use of necessary supplemental water are also supplied as specified in the Compact, the following rules and regulations are adopted subject to the provisions for amendment, revision or abrogation as provided herein.

Article I. Collection of Water Records.

A. It shall be the joint and equal responsibility of the members of the states of Wyoming and Montana to collect, cause to be collected or otherwise furnish records of tributary stream flow at the points of measurement specified in Article V (B) of the Compact, or as near thereto as is physically or economically feasible or justified.

1. Clarks Fork

The gaging station known as Clarks Fork at Edgar, Montana and which is located in SW 1/4, sec. 24, T.4 S., R.24 E., shall temporarily be the point of measurement for the Clarks Fork, subject to whatever mutually agreeable corrections to the streamflow records at this point as may be deemed practical to meet the terms of the Compact.

2. Bighorn River (exclusive of Little Bighorn River)

The gaging station known as the Bighorn River near Custer, Montana and located near the center of sec. 10, T.4 N., R.34 E., shall temporarily be the designated point of measurement on that stream. The flow of the Little Bighorn River as measured at the gaging station near Hardin, Montana and located in S 1/2, SE 1/4 sec. 18, T.1 S., R.34 E., shall be considered the point of measurement for that stream, except that if or when satisfactory records are not available, the records for the nearest upstream station with practical corrections for intervening inflow or diversion shall be used.

3. Tongue River

The gaging station known as the Tongue River at Miles City, Montana and located in SE 1/4, sec. 23, T.7 N., R.47 E., shall temporarily be the point of measurement for that stream.

4. Powder River

The gaging station known as the Powder River near Locate, Montana and located in NE 1/4, sec. 26, T.8 N., R.51 E., shall temporarily be the designated point of measurement for that stream.

B. Records of total annual diversion in acre-feet above the points of measurement designated in the Compact for irrigation, municipal and industrial uses developed after January 1, 1950 shall be furnished by the members of the Commission for their respective states, at such time as the Commission deems necessary for interstate administration as provided by the terms of the Compact. Providing that if it be acceptable to the Commission, reasonable estimates thereof may be substituted.

C. Annual records of the net change in storage in all reservoirs, not excluded under Article V (E) of the Compact, above the specified point of measurement specified in the Compact and completed after January 1, 1950, and the annual net change in reservoirs existing prior to January 1, 1950, which is used for irrigation, municipal and industrial purposes developed after January 1, 1950, shall be the primary responsibility of the member of the Commission in whose state such works are located; providing, such data is not furnished by federal agencies under the provisions of Article III (D) of the Compact, or, collected by the Commission.

Article II. Office and Officers.

A. The office of the Commission shall be located, and be that of the United States Geological Survey in Helena, Montana.

B. The Chairman of the Commission shall be the federal representative as provided in the Compact.

C. The Secretary of the Commission shall be as provided for in Article III of these rules.

D. The credentials of each member of the Commission shall be placed on file in the office of the Commission.

Article III. Secretary

A. The Commission, subject to the approval of the Director of the United States Geological Survey, shall enter into cooperative agreements with the U. S. Geological Survey for such engineering and clerical services as may reasonably be necessary for the administration of the Compact. Said agreements shall provide that the Geological Survey shall:

1. Maintain and operate gaging stations at or near the points of measurement specified in Article V (A) of the Compact.

2. Assemble factual information on stream flow, diversion and reservoir storage for the preparation of an annual report to the Governors of the signatory states.

3. Make such investigations and reports as may be requested by the Commission in aid of its administration of the Compact.

B. Act as Secretary to the Commission.

Article IV. Budget

A. At the annual meeting of each even numbered year or prior thereto, the Commission shall adopt a budget for operation during the ensuing biennium beginning July first. Such budget shall set forth the total cost of construction, maintenance and operation of gaging stations, the cost of engineering and clerical aid, and other necessary expenses excepting the salaries and personal expenses of the Commissioners. On odd-numbered years revisions of the budget shall be considered.

B. It shall be the obligation of the Commissioners of the States of Montana and Wyoming to endeavor to secure from the Legislature of their respective states sufficient funds with which to meet the obligations of this Compact, except insofar as provided by the federal government.

Article V. Meetings

An annual meeting of the Commission shall be held on the third Tuesday of each November at some mutually agreeable point in the Yellowstone River Basin for consideration of the annual report for the water year ending the preceding September 30th, and for the transaction

of such other business consistent with its authority; provided that by unanimous consent of the Commission the date and place of the annual meeting may be changed. Other meetings as may be deemed necessary shall be held at a time and place set by mutual agreement, for the transaction of any business consistent with its authority.

No action of the Commission shall be effective until approval by the Commissioners for the States of Wyoming and Montana.

Article VI. Amendments, Revisions and Abrogations.

The Rules and Regulations of the Commission may be amended or revised by a unanimous vote at any meeting of the Commission.

Alex D. McDermott
Commissioner for Montana

Floyd A. Bishop
Commissioner for Wyoming

ATTESTED:

Frank Stermitz
Federal Representative

Adopted November 17, 1953
Amended November 16, 1959

MONTHLY SUMMARY OF DISCHARGE
Clarks Fork Yellowstone River at Edgar, Montana

Location.--Lat 45°28'00", long 108°50'30", in SE1/4 SE1/4 sec.23, T.4 S., R.23 E., on right bank just downstream from highway bridge, half a mile east of Edgar, 6 miles upstream from Rock Creek, and at mile 27.0.

Drainage area.--2,032 sq mi.

Records available.--July 1921 to September 1968. Prior to October 1956, published as Clarks Fork at Edgar. Monthly discharge only for some periods, published in WSP 1309. Records since January 1950 available in annual reports of Yellowstone River Compact Commission.

Gage.--Digital water-stage recorder. Altitude of gage is 3,440 ft (by barometer). Prior to Sept. 18, 1940, chain gage, Sept. 18, 1940, to Aug. 31, 1953, wire-weight gage, and Sept. 1, 1953, to June 13, 1966, graphic water-stage recorder, all at present site and datum.

Average discharge.--47 years, 1,046 cfs (757,300 acre-ft per year).

Extremes.--Maximum discharge during year, 7,890 cfs June 21 (gage height, 7.49 ft); minimum, 228 cfs Apr. 30, but may have been less during period of ice effect.

1921-68: Maximum discharge observed, 10,900 cfs June 2, 1936 (gage height, 8.62 ft); minimum, 36 cfs Apr. 22, 1961.

Remarks.--Records good except those for winter period, which are poor. Diversions for irrigation of about 41,500 acres, of which about 840 acres lies below station. In addition, about 6,300 acres of land above station are irrigated by diversions from the adjoining Rock Creek basin. See next page for data on the flow of Whitehorse Canal and Clarks Fork Yellowstone River near mouth.

Month	Second-foot days	Maximum	Minimum	Mean	Runoff in acre-feet
October 1967	21,601	1,010	494	697	42,840
November	18,044	678	440	601	35,790
December	14,020	540	320	452	27,810
January 1968	12,980	500	280	419	25,750
February	11,996	520	280	414	23,790
March	12,933	482	376	417	25,650
April	11,132	490	248	317	22,080
May	23,471	2,700	336	757	46,550
June	142,500	7,200	2,780	4,750	282,600
July	66,707	3,320	901	2,152	132,300
August	41,688	3,620	680	1,345	82,690
September 1968	23,971	1,150	498	799	47,550
Water year 1967-68	401,043	7,200	248	1,096	795,400

MONTHLY SUMMARY OF DISCHARGE
Clarks Fork Yellowstone River at Edgar, Montana

Supplementary Data

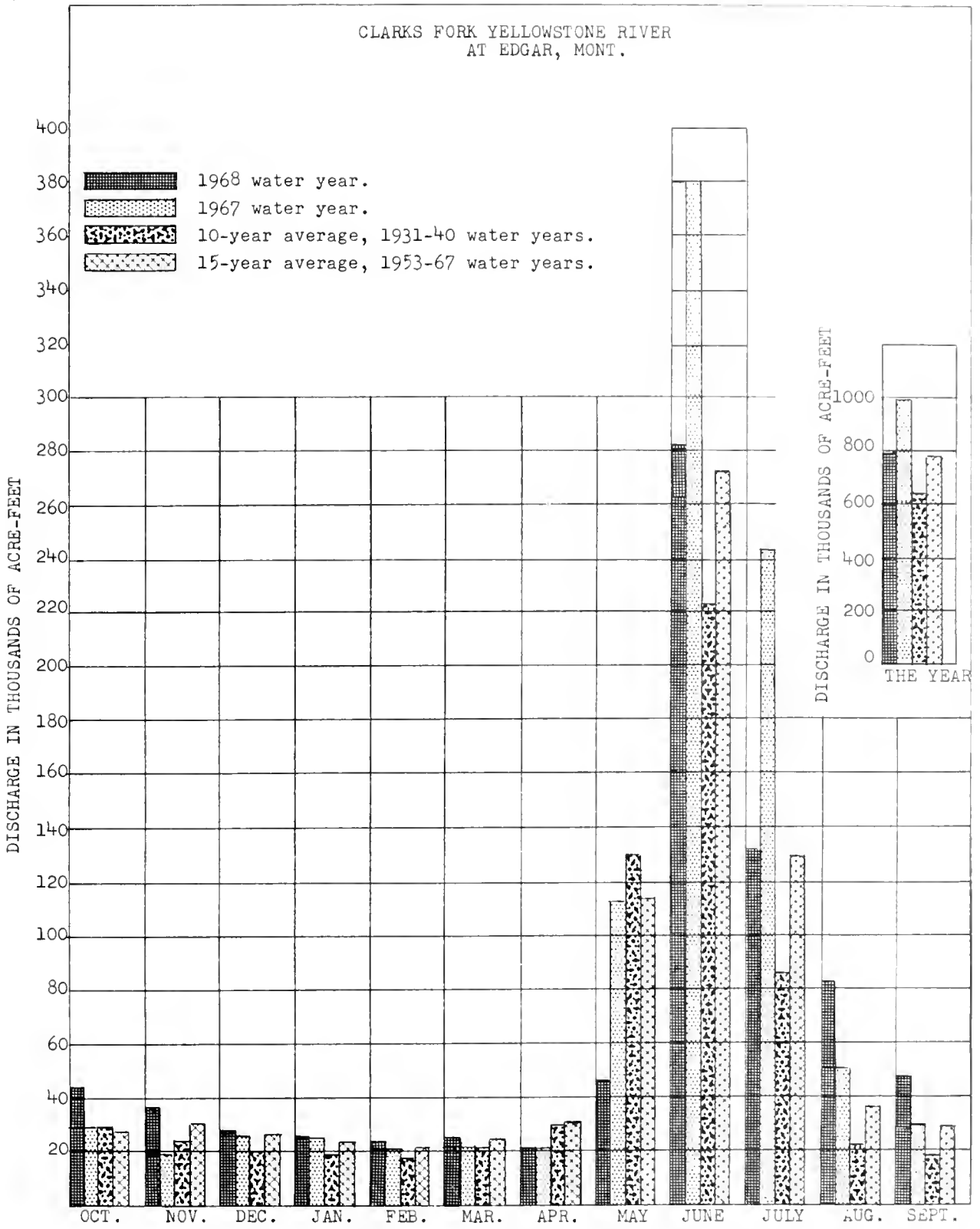
The Compact specified the official point of measurement of the Clarks Fork Yellowstone River shall be just above the mouth of Rock Creek about 6 miles downstream from the gaging station at Edgar. The known intervening diversion is the Whitehorse Canal which begins in SW1/4 sec.1, T.4 S., R.23 E., about 4 miles downstream from the gaging station. The canal serves about 1,000 acres. Based upon periodic discharge measurements of the diversion and information on canal operation, that seasonal diversion is estimated at about 12,000 acre-feet.

Periodic discharge measurements of the Clarks Fork Yellowstone River in SE1/4 sec.1, T.4 S., R.23 E., about half a mile downstream from the Whitehorse Canal diversion and the Whitehorse Canal are tabulated below. Concurrent discharge shown for the gaging station at Edgar is approximately adjusted for lag time. The indicated inflow may generally be return flow from irrigated lands served by Rock Creek water.

Discharge in cfs at selected points

Date	Clarks Fork at Edgar	Whitehorse Canal	Clarks Fork at SE1/4 sec.1	Apparent inflow in reach
Sept. 19, 1967	625	23.2	688	+ 86
Oct. 19	660	17.3	660	+ 17
Nov. 20	625	0	660	+ 35
Mar. 12, 1968	408	0	427	+ 19
Apr. 17	387	18.0	415	+ 46
May 15	666	35.5	653	+ 23
June 19	-	53.4	-	-
July 16	2,460*	40.5	2,270	-150
Aug. 12	1,200	34.8	1,220	+ 55
Sept. 18	575	9.9	592	+ 27
Oct. 9	666	2.8	703	+ 40

* Some uncertainty as to equivalent discharge due to large diurnal fluctuation.



Comparison of discharge during 1968 water year with 1967 water year and with average discharge for water years 1931-40 and 1953-67.

MONTHLY SUMMARY OF DISCHARGE
Little Bighorn River near Hardin, Montana

Location.--Lat 45°44' 10", long 107°33' 25", in NE1/4 NE1/4 sec.19, T.1 S., R.34 E., on left bank, 50 ft downstream from bridge on Sarpy Road, a quarter of a mile upstream from terminal wasteway of Agency Canal, half a mile upstream from mouth, and 21/2 miles east of Hardin.

Drainage area.--1,294 sq mi.

Records available.--June 1953 to September 1968

Gage.--Water-stage recorder. Altitude of gage is 2,890 ft (from topograp. c map). Prior to Oct. 7, 1953, wire-weight gage at site 0.4 mile downst am, Oct. 7, 1953, to May 6, 1963, water-stage recorder at site 0.3 mile d n-stream. May 6, 1963, to Nov. 6, 1963, staff gage at site 0.4 mile do n-stream. All at different datums.

Average discharge.-- 15 years, 251 cfs (181,720 acre-ft per year).

Extremes.--Maximum discharge during year, 4,500 cfs June 11 (gage height, 7.07 ft); minimum, 46 cfs Nov. 28, result of discharge measurement.

1953-68: Maximum discharge, 4,520 cfs Apr.2, 1965; maximum gage height, 11.78 ft Mar. 20, 1960, site and datum then in use (backwater from ice); minimum discharge observed, 0.20 cfs Aug. 7, 1961, result of discharge measurement.

Remarks.--Records good except those for winter period, which are poor. Diversions for irrigation of about 17,000 acres above station. Flow partly regulated by Willow Creek Reservoir (capacity, 23,000 acre-ft). Figures of discharge given herein include flow of terminal wasteway of Agency Canal.

Month	Second-foot days	Maximum	Minimum	Mean	Runoff in acre-feet
October 1967	5,325	202	149	172	10,560
November	5,130	210	60	171	10,180
December	4,180	180	90	135	8,290
January 1968	5,470	440	90	176	10,850
February	10,530	1,100	110	363	20,890
March	13,572	960	211	438	26,920
April	6,810	305	186	227	13,510
May	15,385	1,020	190	496	30,520
June	59,440	4,280	1,070	1,981	117,900
July	14,012	1,000	221	452	27,790
August	8,201	452	164	265	16,270
September 1968	7,371	286	208	246	14,620
Water year 1967-68	155,426	4,280	60	425	308,300

MONTHLY SUMMARY OF DISCHARGE
Bighorn River at Bighorn, Montana

Location.--Lat 46°08'50", long 107°28'00", in NE1/4 NE1/4 sec.33, T.5 N., R.34 E., on right bank just downstream from bridge on old U.S. Highway 10, a quarter of a mile downstream from bridge on Interstate Highway 94, three-quarters of a mile upstream from mouth, 1 mile southwest of Bighorn, and 4 miles east of Custer.

Drainage area.--22,885 sq mi. At site used prior to Oct. 7, 1955, 22,410 sq mi.

Records available.--May 1945 to September 1968. Published as "near Custer," 1945-55. Records since January 1950 available in annual reports of Yellowstone River Compact Commission.

Gage.--Water-stage recorder. Altitude of gage is 2,690 ft (by barometer). May 11 to Dec. 6, 1945, wire-weight gage, and Dec. 7, 1945, to Oct. 6, 1955, water-stage recorder, at site 4 miles upstream at different datum.

Average discharge.--23 years, 3,738 cfs (2,706,000 acre-ft per year), unadjusted.

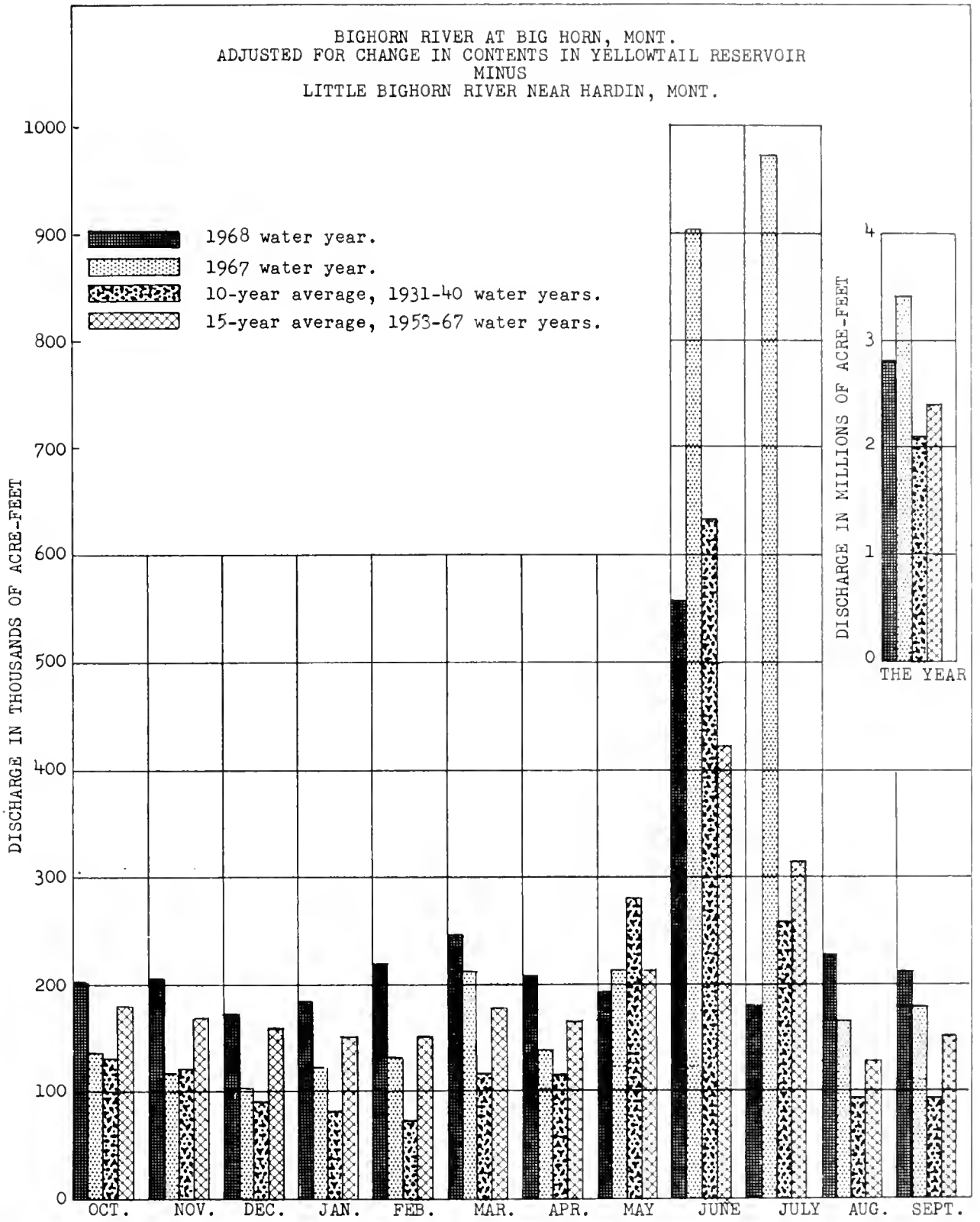
Extremes.--Maximum discharge during year, 23,200 cfs June 11 (gage height, 9.62 ft); minimum daily, 673 cfs Nov. 3.

1945-68: Maximum discharge, 26,200 cfs June 24, 1947 (gage height, 8.79 ft, site and datum then in use), from rating curve extended above 12,500 cfs by logarithmic plotting; maximum gage height recorded, 14.21 ft Apr. 2, 1965; minimum discharge, about 275 cfs Nov. 15, 1959, result of freezeup; minimum daily, 40 cfs Apr. 4, 1967.

Remarks.--Records good except those for period of backwater from Yellowstone River, which are poor. Flow regulated by Yellowtail Reservoir beginning November 1965 (usable capacity, 1,356,000 acre-ft). Major regulation prior to November 1965 by 14 reservoirs in Wyoming and 1 in Montana with combined usable capacity of about 1,400,000 acre-ft (see Appendices C and D). Diversions for irrigation of about 465,000 acres above station.

Month	Second-foot days	Maximum	Minimum	Mean	Runoff in acre-feet	Adjusted Runoff in acre-feet*
Oct. 1967	102,570	4,070	2,150	3,309	203,400	214,400
Nov.	114,230	6,120	850	3,808	226,600	216,600
Dec.	146,930	5,780	2,760	4,740	291,400	180,100
Jan. 1968	169,810	6,730	4,190	5,478	336,800	195,700
Feb.	135,000	6,760	4,100	4,655	267,800	240,800
Mar.	154,480	5,720	3,910	4,983	306,400	272,700
April	121,040	4,670	3,330	4,035	240,100	221,400
May	139,180	6,910	2,710	4,490	276,100	227,000
June	320,490	21,400	5,920	10,680	635,700	676,300
July	93,350	6,250	1,700	3,011	185,200	207,900
August	77,210	3,410	2,040	2,491	153,100	246,700
Sept. 1968	114,160	4,050	3,370	3,805	226,400	226,800
Water year 1967-68	1,688,450	21,400	850	4,613	3,349,000	3,126,400

*Adjusted for change in contents in Yellowtail Reservoir



Comparison of discharge during 1968 water year with 1967 water year and with average discharge for water years 1931-40 and 1953-67.

MONTHLY SUMMARY OF DISCHARGE
Tongue River at Miles City, Montana

Location.--Lat 46°21', long 105°48', in SE1/4 sec.23, T.7 N., R.47 E., on right bank 4 miles south of Miles City and 8 miles upstream from mouth.

Drainage area.--5,379 sq mi.

Records available.--April 1938 to April 1942, April 1946 to September 1968. Published as "near Miles City" April 1938 to April 1942. Not equivalent to records published as "near Miles City" May 1929 to October 1932. Monthly discharge only for some periods, published in WSP 1309. Records since January 1950 available in annual report of Yellowstone River Compact Commission.

Gage.--Water-stage recorder. Altitude of gage is 2,370 ft (by barometer). April 1938 to April 1942, wire-weight gage at site 8 miles upstream at different datum. April 1946 to Sept. 30, 1963, at datum 1.00 ft higher.

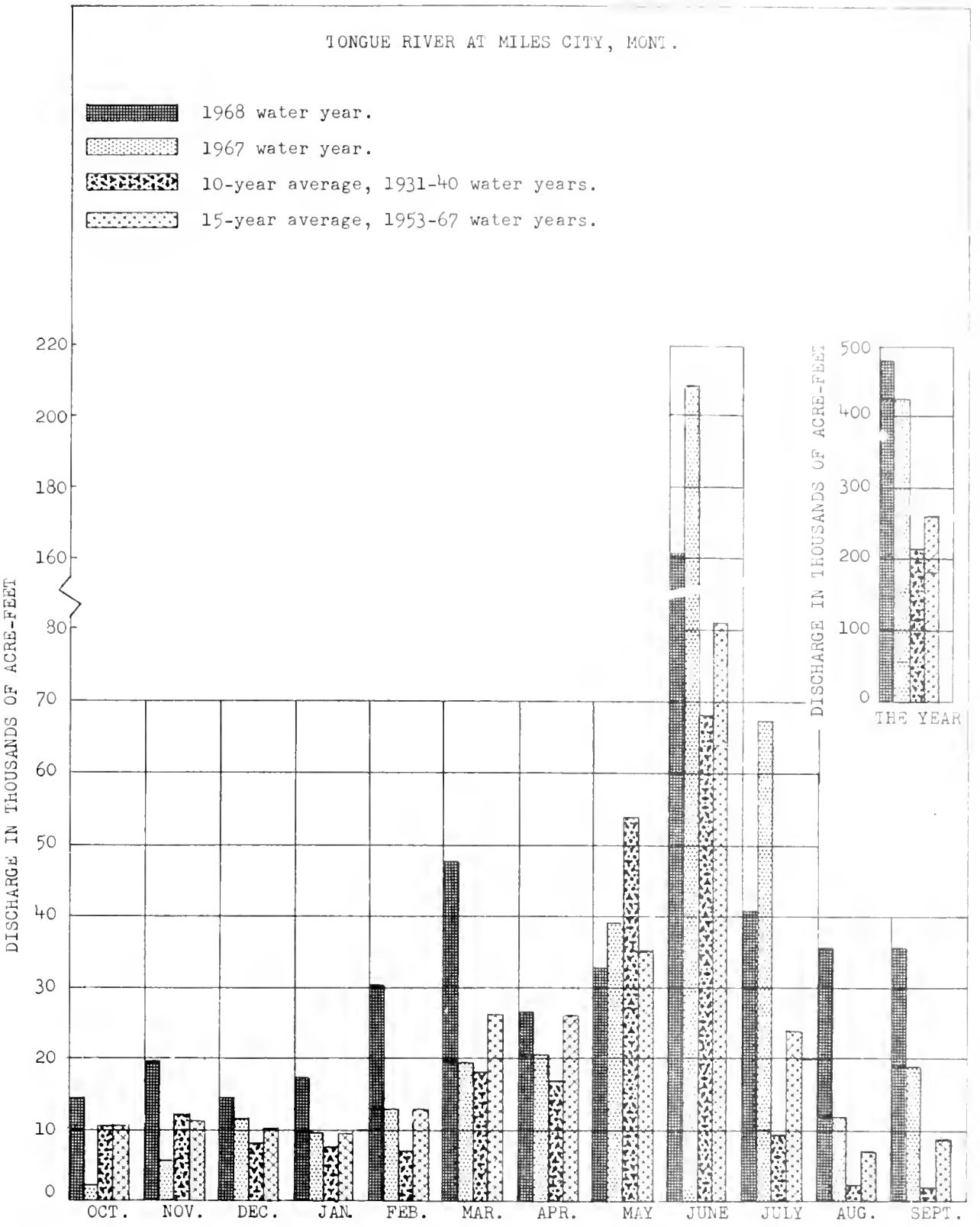
Average discharge.--25 years (1938-41, 1946-68), 390 cfs (282,300 acre-ft per year).

Extremes.--Maximum discharge during year, 5,120 cfs Aug. 24 (gage height, 7.82 ft); minimum daily, 90 cfs Dec. 20-22.

1938-42, 1946-68: Maximum discharge, 13,300 cfs June 15, 1962 (gage height, 12.33 ft, present datum), from rating curve extended above 5,200 cfs on basis of float measurement; maximum gage height, 13.27 ft (present datum) Mar. 19, 1960 (ice jam); no flow July 9-19, Aug. 13, 14, Sept. 28, 1940.

Remarks.--Records good except those for winter period, which are poor. Diversions for irrigation of about 90,000 acres above station. Flow regulated by Tongue River Reservoir (Appendix C) and many small reservoirs in Wyoming (combined capacity, about 15,000 acre-ft).

Month	Second-foot days	Maximum	Minimum	Mean	Runoff in acre-feet
October 1967	7,162	300	158	231	14,210
November	9,810	420	160	327	19,460
December	7,330	560	90	236	14,540
January 1968	8,800	560	130	284	17,450
February	15,390	2,070	220	531	30,530
March	24,049	1,880	528	776	47,700
April	13,454	524	216	448	26,690
May	16,649	1,570	198	537	33,020
June	81,902	4,340	894	2,730	162,500
July	20,538	1,650	324	663	40,740
August	17,890	3,380	254	577	35,480
September 1968	17,963	705	532	599	35,630
Water year 1967-68	240,937	4,340	90	658	477,950



Comparison of discharge during 1968 water year with 1967 water year and with average discharge for water years 1931-40 and 1953-67.

MONTHLY SUMMARY OF DISCHARGE
Powder River near Locate, Montana

Location.--Lat 46°27', long 105°19', in SW1/4 sec.14, T.8 N., R.51 E., on left bank 1.5 miles downstream from bridge on U. S. Highway 12 at present site of Locate (5 miles west of former site of Locate), 1.5 miles upstream from Locate Creek, and 25 miles east of Miles City.

Drainage area.--13,194 sq mi (revised). 13,189 sq mi at site used prior to Oct. 1, 1965.

Records available.--March 1938 to September 1968. Records since January 1950 available in annual reports of Yellowstone River Compact Commission.

Gage.--Water-stage recorder with pressure recording bubbler system. Altitude of gage is 2,390 ft (by barometer). Prior to July 11, 1947, wire-weight gage at bridge 1.5 miles upstream and July 11, 1947, to Sept. 30, 1965, water-stage recorder at sites near bridge at different datum. Oct. 1, 1965, to Oct. 4, 1966, wire-weight gage at present site and datum.

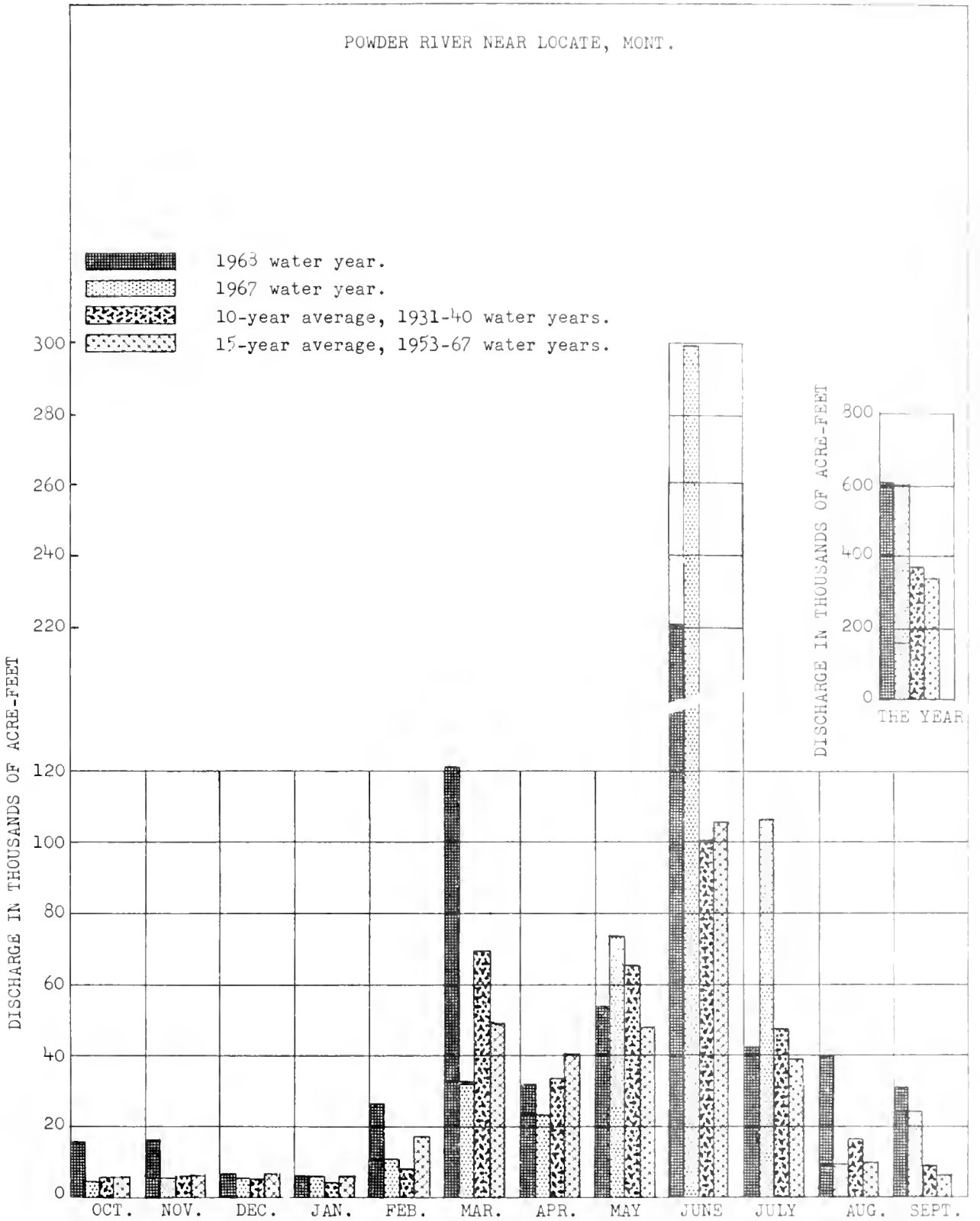
Average discharge.--30 years, 602 cfs (435,800 acre-ft per year).

Extremes.--Maximum discharge during year, 10,200 cfs June 12 (gage height, 7.48 ft); minimum daily, 40 cfs Nov. 27.

1938-68: Maximum discharge observed, 31,000 cfs Feb. 19, 1943 (gage height, 11.23 ft, site and datum then in use), from rating curve extended above 17,000 cfs; no flow Jan. 16 to Feb. 12, Feb. 22-24, 1950, July 27, Sept. 21-27, Oct. 1, 1960, Sept. 4-8, 1961.

Remarks.--Records good except those for winter period, which are poor. Some regulation by three reservoirs in Wyoming with combined usable capacity of 36,800 acre-ft. Diversions for irrigation of about 52,000 acres above station.

Month	Second-foot days	Maximum	Minimum	Mean	Runoff in acre-feet
October 1967	7,969	357	203	257	15,810
November	8,287	412	40	276	16,440
December	3,560	160	50	115	7,060
January 1968	3,260	150	50	105	6,470
February	13,320	3,000	60	459	26,420
March	61,198	8,000	538	1,974	121,400
April	15,966	591	469	532	31,670
May	27,387	2,960	401	883	54,320
June	111,190	9,450	1,500	3,706	220,500
July	21,770	1,740	207	702	43,180
August	20,071	3,150	157	647	39,810
September 1968	15,332	943	313	511	30,410
Water year 1967-68	309,310	9,450	40	845	613,490



Comparison of discharge for 1968 water year with 1967 water year and with average discharge for water years 1931-40 and 1953-67.

RESERVOIRS COMPLETED AFTER JANUARY 1, 1950

BOYSEN RESERVOIR

Water-stage recorder at dam on Wind River, about 21 miles south of Thermopolis, Wyoming. Reservoir formed by earth-fill dam, construction of which began in 1947. Storage began Oct. 11, 1951. Dead storage, 59,880 acre-ft at elevation 4,657.0 ft. Usable contents, 742,100 acre-ft at elevation 4,725.0 ft (top of gates). Crest of dam at elevation, 4,758 ft.

Records given herein represent usable contents. Water is used for irrigation and power development. Allocation for flood control provided. Data furnished by U. S. Bureau of Reclamation.

Extremes.--Maximum usable contents during year, 740,000 acre-ft Aug. 26 (elevation, 4,724.89 ft); minimum, 411,900 acre-ft May 20 (elevation, 4,704.89 ft).

1953-68: Maximum usable contents, 862,700 acre-ft July 7, 1967; minimum, 189,800 acre-ft Mar. 18, 19, 1956 (elevation, 4,684.18 ft).

Month	Water-surface elevation in feet	Contents in acre-ft	Change in contents during month in acre-ft
September 30, 1967	4,721.88	682,700	-
October 31	4,722.05	685,900	+ 3,200
November 30	4,720.15	651,200	-34,700
December 31	4,717.83	610,300	-40,900
January 31, 1968	4,715.85	576,700	-33,600
February 29	4,712.83	528,000	-48,700
March 31	4,710.40	490,900	-37,100
April 30	4,706.56	435,000	-55,900
May 31	4,706.11	428,700	- 6,300
June 30	4,723.05	704,600	+275,900
July 31	4,723.57	714,500	+ 9,900
August 31	4,724.71	736,500	+22,000
September 30, 1968	4,723.05	704,600	-31,900
Water year 1967-68			+21,900

* Does not include dead storage of 59,880 acre-ft.

RESERVOIRS COMPLETED AFTER JANUARY 1, 1950

ANCHOR RESERVOIR

Water-stage recorder at dam on South Fork Owl Creek, 32 miles west of Thermopolis, Wyoming. Reservoir formed by thin concrete arch dam, construction of which began in 1957. Closure of dam made Nov. 21, 1960. Temporary outlet at elevation 6,304.30 ft still in use. Lowest permanent outlet sill at elevation 6,343.75 ft, (contents, 148 acre-ft). Total contents, 17,350 acre-ft at upper active capacity level of 6,441 ft. Crest of dam at elevation 6,452.5 ft.

Records given in this report are total contents. Data furnished by U. S. Bureau of Reclamation.

Month	Water-surface elevation in feet	Contents in acre-ft*	Change in contents during month in acre-ft
September 30, 1967	6,304.30	0	-
October 31	6,304.30	0	0
November 30	6,304.30	0	0
December 31	6,304.30	0	0
January 31, 1968	6,304.30	0	0
February 29	6,304.30	0	0
March 31	6,304.30	0	0
April 30	6,304.30	0	0
May 31	6,304.30	0	0
June 30	6,370.85	1,140	+1,140
July 31	6,304.30	0	-1,140
August 31	6,356.70	442	+ 442
September 30, 1968	6,304.30	0	- 442
Water year 1967-68			0

* Includes dead storage.

RESERVOIRS COMPLETED AFTER JANUARY 1, 1950

YELLOWTAIL RESERVOIR

Water-stage recorder at dam on Bighorn River, 15.5 miles southwest of St. Xavier, Montana. Reservoir formed by concrete arch dam, construction of which began in 1961. Storage began Nov. 3, 1965. Dead storage, 18,970 acre-ft at elevation 3,296.5 ft. Usable contents, 1,356,000 acre-ft at elevation 3,657.0 ft. Crest of dam at elevation 3,660.0 ft.

Records given herein represent usable contents. Water is used for irrigation, power development and recreation. Allocation for flood control provided. Data furnished by U. S. Bureau of Reclamation.

Extremes.--Maximum usable contents during year, 1,068,000 acre-ft Nov. 2 (elevation, 3,637.65 ft); minimum, 667,400 acre-ft May 22 (elevation, 3,585.68 ft).

Month	Water-surface elevation in feet	Contents in acre-ft*	Change in contents during month in acre-ft
September 30, 1967	3,636.29	1,052,000	-
October 31	3,637.29	1,063,000	+ 11,000
November 30	3,636.37	1,053,000	- 10,000
December 31	3,625.40	941,700	- 111,300
January 31, 1968	3,607.17	800,600	- 141,100
February 29	3,603.22	773,600	- 27,000
March 31	3,598.02	739,900	- 33,700
April 30	3,595.00	721,200	- 18,700
May 31	3,586.52	672,100	- 49,100
June 30	3,593.58	712,700	+ 40,600
July 31	3,597.31	735,400	+ 22,700
August 31	3,611.51	829,000	+ 93,600
September 30, 1968	3,611.58	829,400	+ 400
Water year 1967-68			- 222,600

* Does not include dead storage of 18,970 acre-ft.

RESERVOIRS IN EXISTENCE ON JANUARY 1, 1950

The extent, if any, of the use of reservoirs in this category which may be subject to Compact allocations was not determined. As a matter of hydrologic interest, the month-end contents in acre feet of four reservoirs are given. The first three reservoirs are in the Bighorn River basin in Wyoming and data on contents were furnished by the U. S. Bureau of Reclamation. Tongue River Reservoir in Montana is operated under the supervision of the Montana Water Resources Board, which agency furnished operating data.

Contents in acre-ft

Month	a/ Bull Lake	b/ Pilot Butte Reservoir	c/ Buffalo Bill Reservoir	d/ Tongue River Reservoir
September 30, 1967	107,100	7,500	311,300	e/ 26,870
October 31	112,200	4,900	268,200	30,900
November 30	110,000	7,100	246,500	27,060
December 31	101,100	11,340	213,800	26,720
January 31, 1968	92,040	21,580	190,500	30,720
February 29	85,170	22,780	179,000	48,500
March 31	80,160	22,300	157,100	45,900
April 30	72,360	28,260	116,000	36,000
May 31	69,700	22,700	92,260	42,020
June 30	137,900	28,940	348,400	60,100
July 31	145,900	12,710	407,900	52,600
August 31	152,200	13,160	384,300	47,980
September 30, 1968	152,400	11,800	355,000	38,270
Change in Contents during water year	+45,300	+4,300	+43,700	+11,400

a/ Total contents, from revised capacity table effective Oct. 1, 1965.

b/ Usable contents. Dead storage is 5,360 acre-ft.

c/ Total contents, from revised capacity table based on survey of 1959. Contents prior to October 1960 based on survey of 1941.

d/ Usable contents. Dead storage is 1,400 acre-ft. Contents based upon sedimentation surveys of October 1948.

e/ Contents interpolated on basis of once weekly readings of reservoir stage.

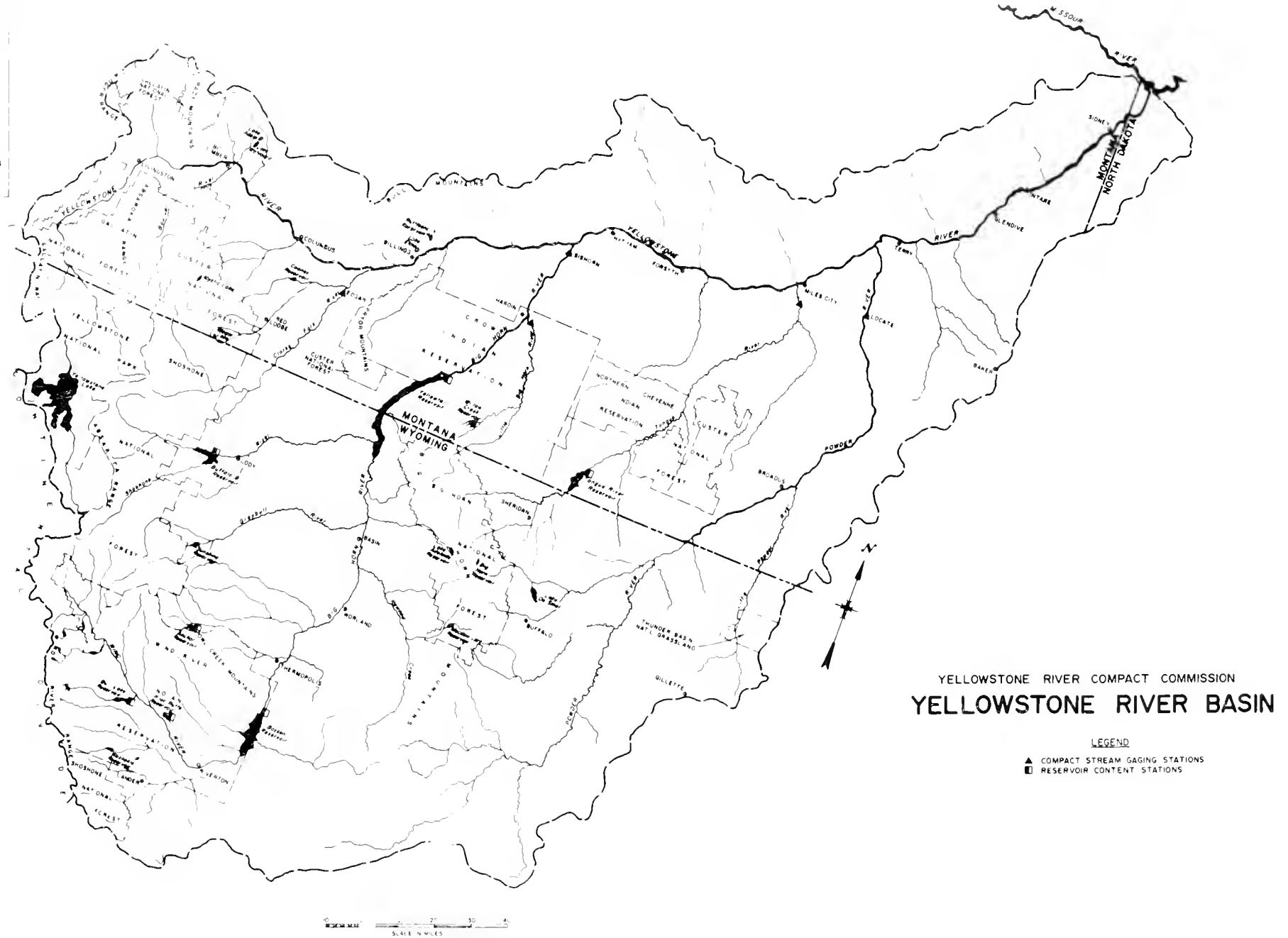
YELLOWSTONE RIVER COMPACT COMMISSION

YELLOWSTONE RIVER BASIN

LEGEND

▲ COMPACT STREAM GAGING STATIONS
◧ RESERVOIR CONTENT STATIONS

LOCATION MAP



YELLOWSTONE RIVER COMPACT COMMISSION

YELLOWSTONE RIVER BASIN

LEGEND

▲ COMPACT STREAM GAGING STATIONS

◧ RESERVOIR CONTENT STATIONS